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Geografske informacije - Poseben model za notranje prostore (ISO/DIS 19164:2023)

Geographic information - Indoor feature model (ISO/DIS 19164:2023)

Geoinformationen - Feature-Modell für Innenräume (ISO/DIS 19164:2023)

Information géographique - Modèle d'entités intérieures (ISO/DIS 19164:2023)

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Various location-based indoor applications, such as indoor navigation, indoor car parking and indoor emergency response, have been increasingly involved in daily lives and managements of public buildings. These applications need information on indoor features (such as floors, rooms, doors and windows) and their spatial associations to describe the environment inside a building. Accordingly, many application systems and related standards also have been developed in recent years.

OGC CityGML 3.0[4] is designed as a universal information model that defines object types and attributes which are useful for a broad range of applications. For the building model, CityGML focuses on the semantic definitions of buildings and their parts (e.g., walls, roofs, dormers, doors, windows, etc.) and the representation of the relations between those features. However, CityGML does not define strict rules as to which semantic objects have to be included in a specific Level of Detail (LoD) model (Gröger and Plümer, 2012).[7] In practical applications, some 3D objects or some attributes of the objects within specific 3D city models are not covered by CityGML (7.6 in Users Guide of CityGML 3). Although the 3D model can be extended by the Application Domain Extension (ADE) mechanism by adding new object types or new properties for specific applications, it is possible to specify different ADEs for different information communities and every ADE may add their specific properties to the same CityGML feature type as they all can belong to the same substitution group(Biljecki et al., 2018).[6] It may also have the problem of semantic heterogeneity in sharing and intergrading datasets.

OGC® IndoorGML 1.1 standard defines the representation and exchange of indoor navigation network models. It aims to establish a common schema for indoor navigation applications by modelling the topology and semantics of indoor spaces, which are needed for the components of navigation networks (OGC 19-011r4)[2] An IndoorGML document contains external links to referenced objects defined in other data sets such as CityGML and IFC (Industry Foundation Classes), where the objects in the external data set include geometric information (OGC 19-011r4).

The Industry Foundation Classes (IFC) (ISO 16739-1:2018), an open international standard for Building Information Model (BIM) data, provide detailed 3D geometries and rich semantics to describe architectural components and engineering constructions of buildings. IFC aims to cover the whole project lifecycle, i.e., the 'plan', 'design', 'construct', 'operate' and 'maintain' phases of buildings with more than 600 classes in different categories. However, IFCs contain too much architectural information and are too complex to be used in their current format for indoor emergency situations(Tashakkori et al., 2015).[11] It is not necessary to use all these classes for a specific application such as indoor navigation (Liu et al., 2021).[9] However, some information on the architectural components and engineering constructions of buildings defined in IFC can be extracted to describe the attributes of indoor features used in location-based indoor applications to describe indoor spatial environments to help people to implement their works or plans efficiently.

In terms of the ISO/TS 19166, it defines a conceptual framework for mapping BIM to Geographic Information Systems (GIS) with three mapping mechanisms, Perspective Definition (B2GPD), Element Mapping (B2GEM) and LOD Mapping (B2GLM). It focuses on the definition of BIM to GIS conceptual mapping requirement and framework without a bi-directional mapping method and the definition of physical schema. It cannot be used directly to guide which indoor features should be extracted from BIM to describe indoor environments for location-based indoor applications. Different information communities may set different rules for the mapping from BIM to GIS and then produce GIS databases with different indoor features for the same building. It would make these databases hard to be shared and integrated.

OGC Indoor Mapping Data Format (IMDF)[5] provides a generalized, yet comprehensive model for any indoor location, providing a basis for orientation, navigation and discovery (19-089r1). IMDF mainly focuses on the contents of individual indoor features related to navigation issues and does not define a general structure of these indoor elements to cover the relationship between indoor spaces or features.

Therefore, a relatively independent and concise indoor feature model is needed for describing the required features of an indoor spatial environment for location-based indoor applications such as indoor navigation, indoor addressing, indoor car parking and indoor emergency response. This model could provide a common reference to guide the collection and organization of indoor spatial information, and serve as the foundation of a conceptual model for data mapping and sharing among various application systems.

This standard defines such an indoor feature model by following the rules of application schema defined in ISO 19109. It can support data interchange between provide a support A dataset compliant with this standard can serve as the common basic database in various location-based indoor applications and facilitate data sharing and integrating among different platforms or applications. The standard would be beneficial to reduce the overlapping efforts in the production of the basic database of buildings, and it also would be useful to transfer indoor-application platforms or systems with little adjustments from one building to another building based on the common basic database. The intention is for various stakeholders (including indoor data producers and users of location-based indoor application systems) to have a unified understanding of these features for unambiguously retrieving information.

Based on this Standard, a series of profiles can be defined for various location-based indoor applications, for example, a profile for indoor navigation or way finding by linking with a geometric and topological relationship defined in IndoorGML, a profile for a fire emergency by adding the features related to firefighting emergency utilities.

This standard provides two informative annexes to present the class-level referenced relationship between the Indoor Feature Model and BuildingModel of CityGML 3.0, IFC of ISO 16739:2018 and IndoorGML.

Geographic information — Indoor feature model

1 Scope

This document defines a core semantic classification system of essential indoor features to describe indoor environments required commonly in various location-based indoor applications of buildings. The scope includes the following:

— semantic description of indoor features and their attributes;

— feature association between indoor features.

The semantic classification system in this document is compatible with the building model defined in existing relative standards. Geometric and topological descriptions of indoor features are not considered in this document. This document does not apply to other architectural structures such as tunnels.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes the requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 19103:2015, *Geographic information — Conceptual schema language*

ISO 19107:2019, *Geographic information — Spatial schema*

ISO 19108:2002, *Geographic information — Temporal schema*

ISO 19109:2015, *Geographic information — Rules for application schema*

ISO 19115-1:2014, *Geographic information — Metadata — Part 1: Fundamentals*

ISO 16739-1:2018, *Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries — Part 1: Data schema*

ISO 6707-1:2020, *Buildings and civil engineering works — Vocabulary — Part 1: General terms*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
feature
abstraction of real-world phenomena

Note 1 to entry: A feature can occur as a type or an instance. Feature type or feature instance should be used when only one is meant.

[SOURCE: ISO 19101-1:2014, 4.1.11]

3.2
feature attribute
characteristic of a *feature* (3.1)

Note 1 to entry: A feature attribute has a name, a data type and a value domain associated with it. A feature attribute for a feature instance also has an attribute value taken from the value domain.

[SOURCE: ISO 19101-1:2014, 4.1.12, modified — Examples 1 and 2 along with Notes 2 and 3 have been deleted.]

3.3
feature association
relationship that links instances of one *feature* (3.1) type with instances of the same or a different *feature type* (3.4)

[SOURCE: ISO 19110:2016, 3.3]

3.4
feature type
class of features having common characteristics

[SOURCE: ISO 19156:2023, 3.9]

3.5
indoor entity feature
feature (3.1) constructed as indoor architectural components or features attached for a specific use inside a building

EXAMPLE Windows, doors, furniture, facilities are indoor entity features.

3.6
indoor space feature
feature (3.1) that may contain *indoor entity features* (3.5) and/or is used as a place for a specific purpose inside a building

EXAMPLE Room, balcony and pathway are indoor space features.

3.7
indoor map
portrayal of an indoor entity and space features as a digital image or vector file suitable for display on a computer screen

4 Symbols and abbreviated terms

4.1 Abbreviations

IFC Industry Foundation Classes

IFM Indoor Feature Model

LBS Location-Based Service

UML Unified Modelling Language

4.2 UML notation

In this document, conceptual schemas are presented in the Unified Modelling Language (UML). ISO 19103 Conceptual schema language presents the specific profile of UML used in this document.

5 Conformance

This document defines one conformance class:

— “Indoor Feature Model” (specification target: Indoor Feature Model);

A specification, standard, test suite, or test tool claiming conformance to this document shall implement the conformance class relevant to that specification target.

Conformance with this document shall be assessed using all the relevant conformance test cases specified in Annex A (normative) of this document.

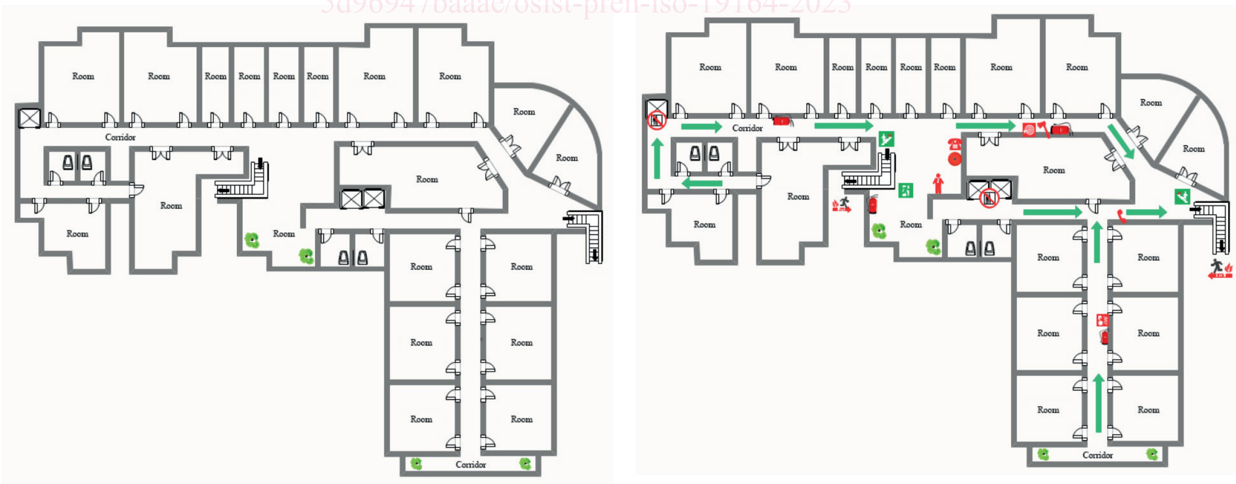
All requirements specified in this document belong to the Indoor Feature Model requirements class, which is identified by the URI https://standards.isotc211.org/19164/-1/req/IndoorFeatureModel

Identifiers of requirements and conformance tests specified in this document are relative to https://standards.isotc211.org/19164/-1

6 General

The Indoor Feature Model (IFM) defines a unified structure and description of the generic indoor features which can be understood consistently by users (including indoor data producers, developers and users of location-based indoor applications). The generic indoor features are the basic components constructing the spatial environments inside a building, and the feature attributes and feature associations provide information about these components. One of the applications of IFM is to provide the spatial information to make an indoor map to represent the spatial layouts of these basic components and their characteristics visually. The indoor map can further be used as the base map to produce a thematic map by adding special features for a specific location-based indoor application.

EXAMPLE A base map of Figure 1 a) shows the basic features and their layouts on a floor in a building, which is defined in this document. a thematic map of Figure 1 b) adds the special features (e.g., fire hydrants, emergency exits) for fire emergency service to the base map.



a) base indoor map **b) thematic indoor map**

Figure 1 — Examples of a base map displaying the layout of the basic indoor features and a thematic map adding specific features for fire emergency service

7 Relationship with the existing standards

Figure 2 illustrates the relationship between IFM defined in this document and other International Standards related to indoor data and application schema. This document follows the rules of application schema defined in ISO 19109. The conceptual schema is presented in UML in conformance with ISO 19103 and refers to data types defined in ISO 19103 and ISO 19115-1.

IFM refers to relative classes and enumerations defined in ISO 16739 (IFC) and CityGML and takes IndoorGML, CityGML and IFC as the external data sources of topological and geometric information of IFM.

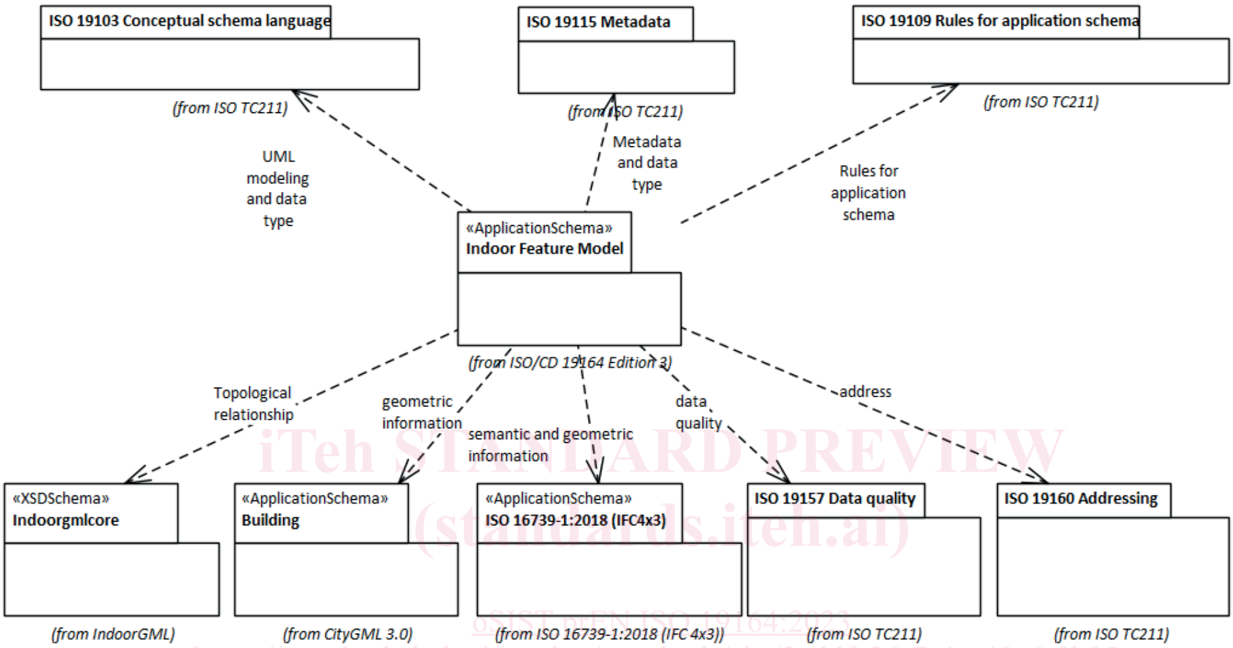


Figure 2 — Relationship with ISO and OGC standards

Following the role of the application pattern defined in 19109 on data interchange, Figure 3 shows the role of IFM on data interchange between supplier data sources and user data sources related to LBS-based applications.

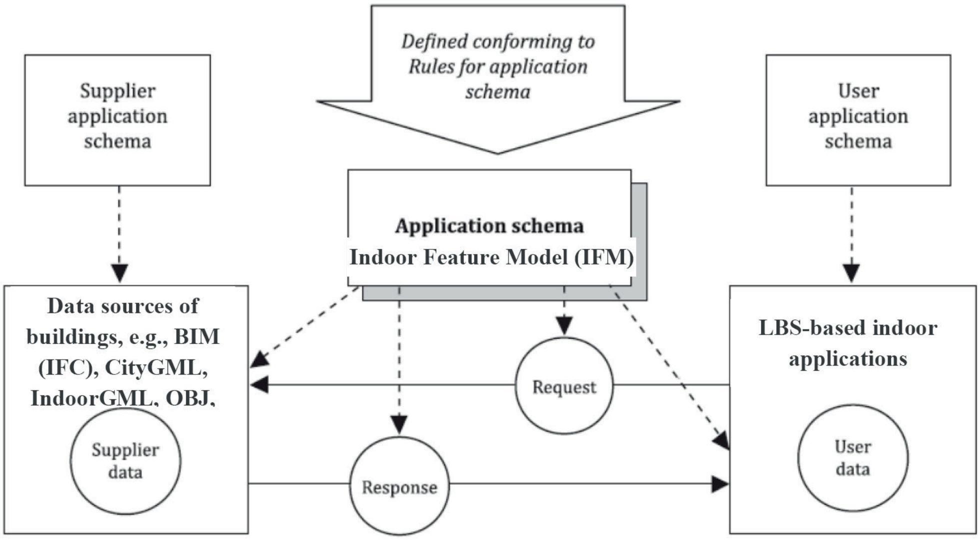


Figure 3 — The role of IFM on data interchange (Modified from Figure 2 in ISO 19109:2015. The unbroken lines show the flow of data. Broken lines denote the role of the application schema on the data interchange.)

8 Indoor Feature Model

8.1 Indoor top features

IFM defines the semantic structure of a minimal set of the generic feature types, feature attributes and feature associations of a building, especially a large public building or office building, with complex structures, multiple functions and diverse public users (Figure 4). These generic feature types should be involved as the basic datasets for location-based indoor applications such as indoor navigation for shopping or car parking, emergency escape, and management of facilities or instruments in a hospital. The building components which are irrelevant to location-based services are not covered in this model.

A building may span over several connected or disconnected buildings to make up a building complex (ISO 16739-1:2018). A building complex (BuildingComplex class) is a complex feature defined in ISO 19109:2015, which is composed of more than one individual buildings (Building class. Each building is composed of multiple floors, also called levels or storeys.

Several floors may have a specific usage or ownership as a building subdivision. The examples of building subdivisions are commercial floors, office floors and accommodation floors in a building. A Floor may composite several floor subdivisions according to the usage and/or ownership. The examples of floor subdivisions are, the waiting area, commercial area, and boarding area on a floor of an airport.

Each floor is composed of various indoor space features and indoor entity features. Indoor space features may contain indoor entity features. *AbstractIndoorSpaceFeature* is an abstract superclass to describe the common attributes of space feature classes. *AbstractIndoorEntityFeature* is an abstract superclass to describe the common attributes of indoor constructive features and attached features.

The detailed descriptions of the attributes of the feature types and their associations are provided in the data dictionary of Annex B. The informative Annex C, D and E present the class-level referenced relationship between the ISO 19164 IFM and the BuildingModel of CityGML 3.0, IFC (ISO 16739-1:2018) and IndoorGML 1.1.

Requirement 1 /req/IndoorFeatureModel/BasicInfo

Each indoor top feature type shall use the basic information as detailed in the data dictionary of Annex B.

